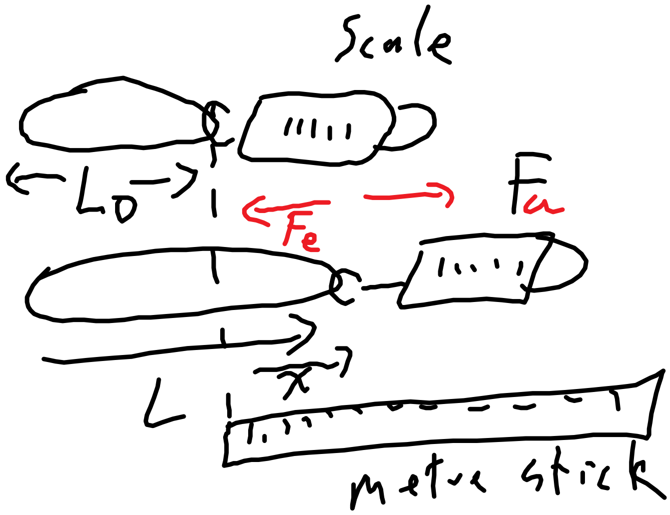
# Hooke's Law - Elastic Forces - not in textbook

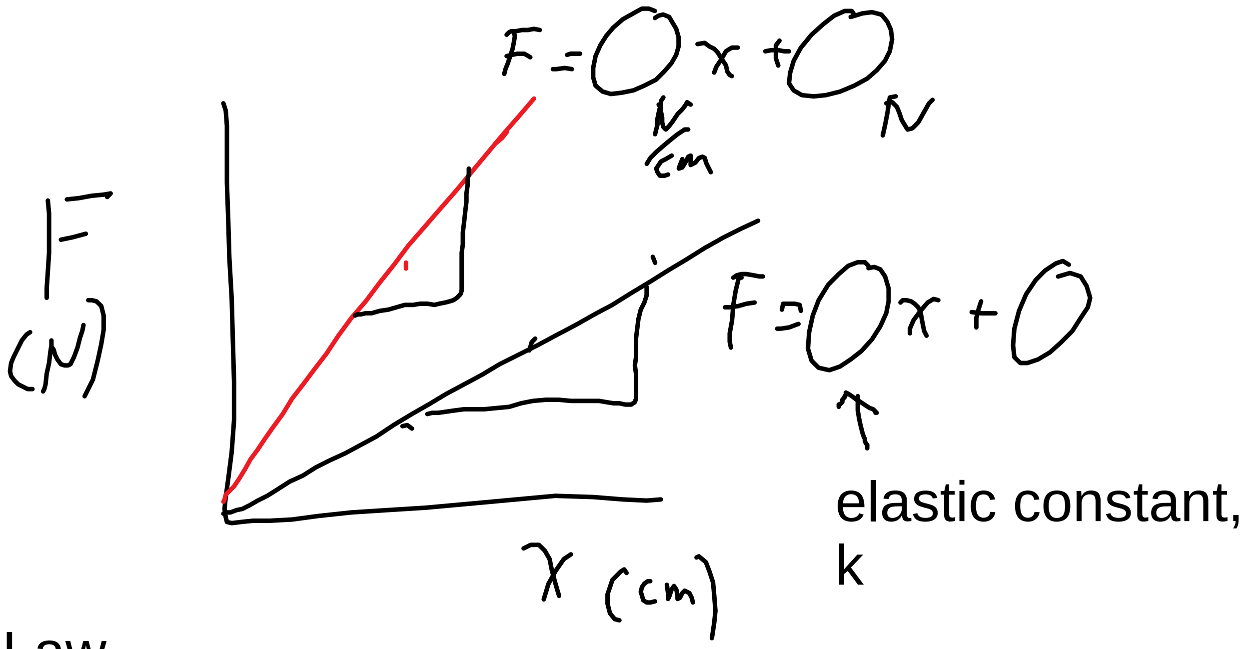
Lab activity - not a report
Hand in Friday graph of the elastic force vs extension on a spring and an elastic band with a equation for each relationship
just the graph with slope calculation and equation




L is the length of the spring or elastic band.
$L_o$ is the length when there is no force.
x is the extension or compression, = $L-L_o$.
$F_e$ is the elastic force = $F_a$ the applied force
Data table:

| x (cm) | $F_e$ of the spring(N) | $F_e$ of the elastic band(N) |
|---|---|---|
| 0 | 0 | 0 |
| 2.0 | | |
| 4.0 | | |
| 6.0 | | |
| 8.0 | | |
| 10.0 | | |
| 12.0 | | |

On one sheet of graph paper, put both sets of values.




Hooke's Law

For a perfectly elastic object, when it is stretched, compressed or twisted - it responds with a force proportion to the change, the elastic force, and will return to the original shape without loss of energy.

$F_e$ is the elastic force, in N

x is the compression, extension or twist, in cm or m.

$F_e = - kx$

negative because the elastic force is opposite the change.

k is the elastic constant, in N/m or N/cm.

1. You pull a spring with a force scale and it stretches from 15.0 cm to 19.0 cm with 6.0 N of force.

a) What is the extension?

b) what is the elastic constant, k, for the spring?

c) What if you hang a 500 g mass from that spring. What will be the new length of the spring?

d) You pull the 500g mass hanging on the spring down 2.0 cm more and let go. What is the acceleration of the mass?

p106-107 q11, 16, 21, 22, 25, 29

from last class:

1. What is the force of gravity between a 50.0kg student and a 60.0 kg student 1.5 m apart? Why do you not feel this force?

$F_g = GMm/r^2$

$=6.67x10^{-11}Nm^2/kg^2(60.0kg)(50.0kg)/(1.5m)^2$

= 6.67x60x50/(1.5x1.5)=8,893.3333

$8.9 \times 10^{-8}$N

2. If $g=9.80m/s^2$ and the radius of the Earth is $6.38 \times 10^6$ m, determine the mass of the Earth.

$F_g= GMm/r^2 = mg$

$M=gr^2/G = 9.8(6.38x10^6)^2/6.67x10^{-11}$

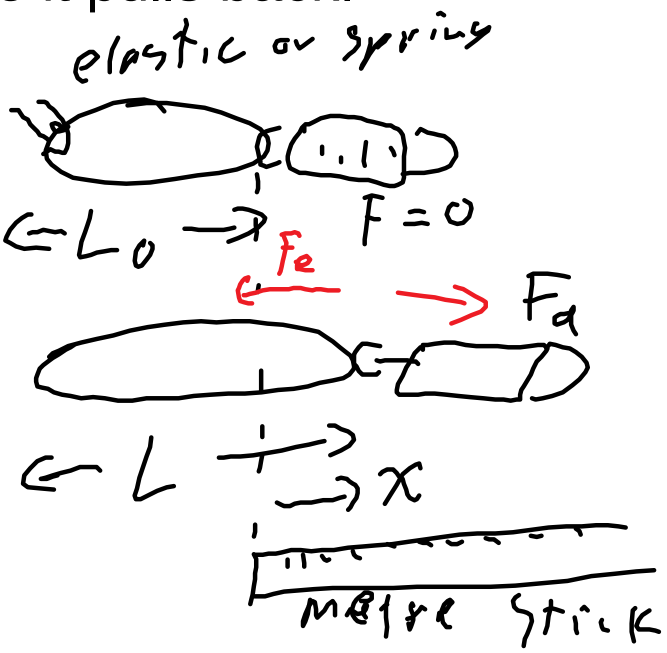
M= 9.8x(6.38x6.38)/6.67=59.8056

$5.98 \times 10^{24}$ kg

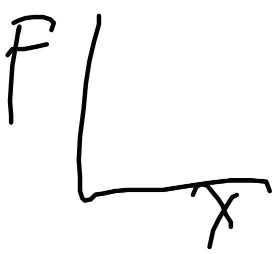
Hookes' Law and Elastic Forces

lab activity - hand in graph with equations Friday - no writeup

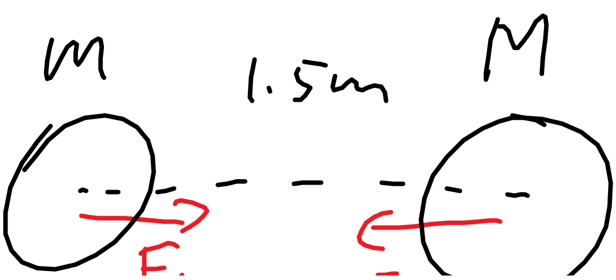
If you pull on an elastic band, it stretches and pulls back. The further you stretch it, the more it pulls back.

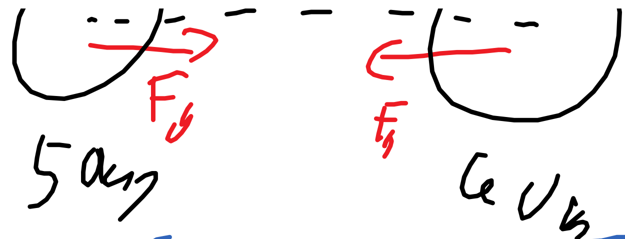



| extension, x (cm) | F(N) spring | F(N) elastic band |
|---|---|---|
| 0 | 0 | 0 |
| 2.0 | | |
| 4.0 | | |
| 6.0 | | |
| 8.0 | | |
| 10 | | |
| 12.0 | | |




both sets on one graph






$$F_g = \frac{GMm}{r^2} = \frac{(6.67\times10^{-11})(50)(60)}{(1.5)^2}$$

$$= 8.9\times10^{-8}\,N$$

↑ very small

2. $g = 9.8\,\frac{N}{kg}$ $\quad r_E = 6.38\times10^{6}\,m$

$M_E = ?$

$$F_g = \frac{GMm}{r^2} = mg \qquad g = \frac{GM}{r^2}$$

$$M = \frac{gr^2}{G}$$

$$M = \frac{9.8\,\frac{N}{kg}\,(6.38\times10^{6}\,m)^2}{6.67\times10^{-11}\,\frac{N\,m^2}{kg^2}}$$

$$M = \frac{9.8\ \frac{N}{kg}\ (6.38\times10^{6}\ m)^2}{6.67\times10^{-11}\ \frac{N m^2}{kg^2}}$$

9.8x6.38x6.38/6.67=59.8056

5.98 x $10^{24}$kg